Hybrid-Electric Rotorcraft Tool Development, Propulsion System Trade Space Exploration, and Demonstrator Conceptual Design, Phase II

Completed Technology Project (2015 - 2017)

Project Introduction

Hybrid-electric propulsion is becoming widely accepted as a potential disruptive technology for aircraft that can provide significant reduction in fuel consumption as well as many other benefits. The majority of the analysis tools that exist today, however, do not harness the capability to analyze these unique systems, especially in the rotorcraft realm. The Phase I effort focused mainly on the development of the PANTHER tool in preparing it for modeling hybrid and all-electric rotorcraft. The tool was then exercised by modeling a handful of propulsion architectures. The goal of the proposed Phase II effort is to further improve upon the strengths of the PANTHER code that was developed, and then utilize this tool to further explore the hybrid-electric rotorcraft design space. Given the goals of the Revolutionary Vertical Lift Technology Project (RVLT), the PANTHER tool must be further expanded to enable the sizing and performance analysis of unique rotorcraft configurations with propulsion system designs unseen in the vertical lift realm. The tool will be expanded with modules for fuel cells and flywheels along with improved engine modules, physics-based motor and drive models, and a new capability to model complete missions. The thermal management aspect will also be addressed with modules for radiators, cooling ducts, fluids, and pumps. With the capability of PANTHER vastly enhanced, numerous trade studies will then be conducted that attempt to explore a large portion of the rotorcraft trade space made possible by hybrid-electric propulsion systems. These trades will aim to answer many of the questions that have arisen in the community about hybrid-electric rotorcraft. Using the results and lessons learned from these studies, and accommodating the goals of NASA and the RVLT project, a detailed conceptual design will be performed on a notional hybrid-electric rotorcraft demonstrator.

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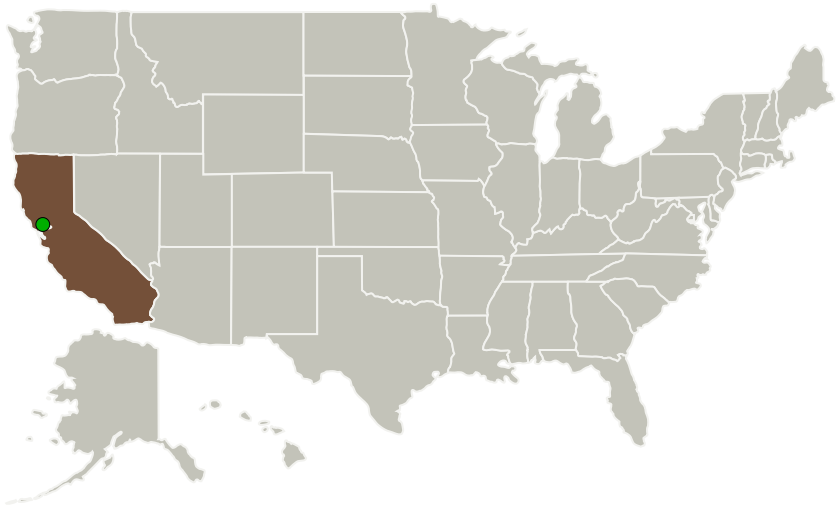
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Empirical Systems Aerospace, Inc.(ESAero)	Lead Organization	Industry	Pismo Beach, California
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Empirical Systems Aerospace, Inc. (ESAero)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Michael W Green

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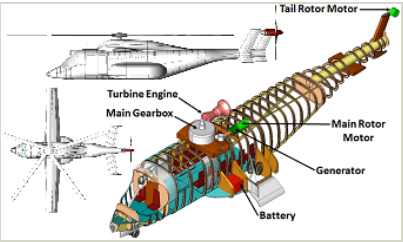
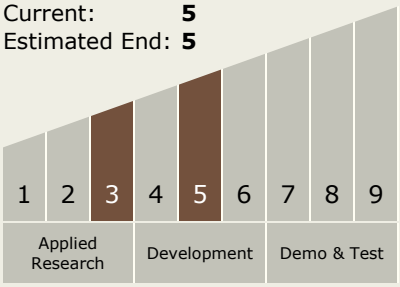
Images



Briefing Chart
Hybrid-Electric Rotorcraft Tool Development, Propulsion System Trade Space Exploration, and Demonstrator Conceptual Design Briefing Chart
(https://techport.nasa.gov/image/129982)

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.1 Software Development, Engineering, and Integrity
    - TX11.1.8 Software Analysis and Design Tools

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System